IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Patent Application

Applicant(s): Aquaro et al.
Docket No.: ~~1-1-36-86~~
Serial No.: 09/516,274
Filing Date: February 29, 2000
Group: 2828
Examiner: Tuan N. Nguyen

I hereby certify that this paper is being deposited on this date with the U.S. Postal Service as first class mail addressed to the Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450
Signature: [signature] Date: October 22, 2003

Title: Method and Apparatus for Coupling a Multimode Laser to a Multimode Fiber

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APPEAL BRIEF

Mail Stop Appeal Brief - Patents
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

Applicants hereby appeal the final rejection dated June 17, 2003, of claims 1 through 16 of the above-identified patent application.

REAL PARTY IN INTEREST

The present application is assigned to Lucent Technologies Inc., as evidenced by an assignment recorded on May 12, 2000 in the United States Patent and Trademark Office at Reel 010790, Frame 0177. The assignee, Lucent Technologies Inc., is the real party in interest.

RELATED APPEALS AND INTERFERENCES

There are no related interferences or appeals.

STATUS OF CLAIMS

Claims 1 through 16 are pending in the above-identified patent application. Claims 1, 8, and 15 remain rejected under 35 U.S.C. §102(b) as being unpatentable over Scifres et al. (United States Patent No. 4,818,062), claims 4 and 11 remain rejected under 35 U.S.C. §103(a) as being unpatentable over Scifres et al. ('062), and claims 7 and 14 remain rejected under 35 U.S.C. §103(a) as being unpatentable over Scifres et al. (United States Patent No. 4,820,010) in view of Rope et al. (United States Patent No. 6,252,715).

STATUS OF AMENDMENTS

There have been no amendments filed subsequent to the final rejection.

SUMMARY OF INVENTION

The present invention is directed to a method and apparatus for coupling a multimode laser to a multimode fiber using a multimode tapered structure (page 4, lines 6-13). The disclosed multimode tapered structure accepts an optical beam having a highly elliptical beam shape and converts the optical beam for acceptance by the circular multimode optical fiber. According to one aspect of the invention, the multimode tapered structure has a tapered form having an elliptical cross section at one end to match the rectangular laser aperture, and a circular cross section at the other end to match the fiber core. (Page 4, line 14, to page 5, line 2.)

ISSUES PRESENTED FOR REVIEW

i. Whether claims 1, 8, and 15 are properly rejected under 35 U.S.C. §102(b) as being unpatentable over Scifres et al. ('062);

ii. Whether claims 4 and 11 are properly rejected under 35 U.S.C. §103(a) as being unpatentable over Scifres et al. ('062); and

iii. Whether claims 7 and 14 are properly rejected under 35 U.S.C. §103(a) as being unpatentable over Scifres et al. ('010) in view of Rope et al.

GROUPING OF CLAIMS

The rejected claims stand and fall together.

ARGUMENT

Independent Claims 1, 8, 15 and 16

Independent claims 1, 8, and 15 are rejected under 35 U.S.C. §102(b) as being unpatentable over Scifres et al. ('062). The Examiner asserts that Scifres shows in Figure 1-4, 8, and 11 a multimode tapered structure (Fig. 2: 17) for coupling a multimode laser (Fig. 2: 11, 45) to a multimode fiber (Fig. 2: 53; Fig. 4: 27, 33). The Examiner further asserts that Scifres shows an actual "end of the tapered structure – Front Fig. #53" that is used to couple to another fiber.

Applicants note, however, that Scifres ('062) is directed to fiber optic waveguides wherein the "input end of the fiber optic waveguides may be squashed into an elongated cross section." Cited, Abstract. Scifres teaches that the light from a laser is then directed to the fiber optic waveguide *without an intervening structure*. The independent claims of the present invention, alternatively, are directed to a "multimode tapered structure" that couples a "multimode laser to a multimode fiber." As set forth in each of the independent claims, the multimode tapered structure must have an "input end having an elliptical cross section for coupling with said multimode laser" and an "output end having a circular cross section for coupling with said multimode fiber." The structure described in Scifres does not have an output end that couples with a fiber, since the structure is a squashed fiber itself!

With the multimode tapered structure of the present invention, the light passes from the laser through the claimed tapered structure to the fiber optic cable. The multimode tapered structure is not optically equivalent to a fiber optic waveguide that has been squashed. In particular, the fiber optic waveguide of Scifres does not have an "output end having a circular cross section *for coupling with said multimode fiber,*" as required by independent claims 1, 8, 15, and 16.

Also, contrary to the Examiner's assertion that the waveguide is coupled to another fiber, Scifres ('062) teaches that the "output end...is...coupled into an end of a solid

state active medium." Col. 2, lines 45-47. Scifres teaches various optical means for connecting the output end to a solid state laser material (col. 6, line 63, to col. 7, line 14; Figs. 5-7). Applicants could find no suggestion in Scifres ('062) to couple the output end to a fiber. Independent claims 1, 8, 15, and 16 are directed to a "multimode tapered structure" for coupling a "multimode laser to a multimode fiber."

Rope et al. was also cited by the Examiner in rejecting claims 7 and 14 for its disclosure that a beam pattern is often elliptical and its disclosure of a focus element where elliptical beams are converted to circular beams for output. Applicants note that Rope et al. is directed to an "optical head assembly, method, and procedure which generates and then precisely positions multiple light beams onto a target." See, Abstract. Rope does not address coupling a multimode laser to a multimode fiber and does not address multimode tapered structures, as required by independent claims 1, 8, 15, and 16.

Scifres ('010) was cited by the Examiner in rejecting claims 7 and 14. The Examiner asserts that Scifres ('010) discloses all the limitations of claims 7 and 14 except an optical beam having a highly elliptical beam shape. Applicants note that Scifres ('010) is directed to an "optical system producing bright light output for optical pumping, communications, illumination and the like in which one or more fiberoptic waveguides receive light from one or more diode lasers or diode laser bars and transmit the light to an output end where it is focused or collimated into a bright light image." See, abstract. Scifres et al. ('010) do not disclose or suggest a "multimode tapered structure" for coupling a "multimode laser to a multimode fiber," as required by independent claims 1, 8, 15, and 16.

<u>Conclusion</u>

Thus, Scifres et al. ('062), Scifres et al. ('010), and Rope et al., alone or in any combination, do not disclose or suggest a "multimode tapered structure" for coupling a "multimode laser to a multimode fiber," as required by independent claims 1, 8, 15, and 16.

The rejections of the independent claims under section 102 and section 103 in view of Scifres et al. ('062), Scifres et al. ('010), and Rope et al. are therefore believed to be improper and should be withdrawn.

The remaining rejected dependent claims are believed allowable for at least the reasons identified above with respect to the independent claims.

The attention of the Examiner and the Appeal Board to this matter is appreciated.

Respectfully,

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APPENDIX

1. A multimode tapered structure for coupling a multimode laser to a multimode fiber, comprising:

an input end having an elliptical cross section for coupling with said multimode laser; and

an output end having a circular cross section for coupling with said multimode fiber.

2. The multimode tapered structure of claim 1, wherein said elliptical cross section approximately matches a rectangular aperture of said multimode laser.

3. The multimode tapered structure of claim 1, wherein said circular cross section approximately matches a core of said multimode fiber.

4. The multimode tapered structure of claim 1, wherein said multimode tapered structure is tapered from a smaller dimension at said input end to a larger dimension at said output end.

5. The multimode tapered structure of claim 1, wherein said multimode tapered structure has a numerical aperture that is selected to provide a desired coupling efficiency.

6. The multimode tapered structure of claim 1, wherein said multimode tapered structure has a length that is selected to provide a desired coupling efficiency.

7. The multimode tapered structure of claim 1, wherein said multimode tapered structure accepts an optical beam having a highly elliptical beam shape and converts said optical beam for acceptance by said circular multimode optical fiber.

8. An optical coupling system, comprising:

a multimode laser source having a rectangular aperture;

a multimode fiber having a core surrounded by a cladding; and

a multimode tapered structure for coupling said multimode laser to said multimode fiber, said multimode tapered structure having an input end and an output end, said input end having an elliptical cross section for coupling with said multimode laser and said output end having a circular cross section for coupling with said multimode fiber.

9. The optical coupling system of claim 8, wherein said elliptical cross section approximately matches said rectangular aperture of said multimode laser.

10. The optical coupling system of claim 8, wherein said circular cross section approximately matches said core of said multimode fiber.

11. The optical coupling system of claim 8, wherein said multimode tapered structure is tapered from a smaller dimension at said input end to a larger dimension at said output end.

12. The optical coupling system of claim 8, wherein said multimode tapered structure has a numerical aperture that is selected to provide a desired coupling efficiency.

13. The optical coupling system of claim 8, wherein said multimode tapered structure has a length that is selected to provide a desired coupling efficiency.

14. The optical coupling system of claim 8, wherein said multimode tapered structure accepts an optical beam having a highly elliptical beam shape and converts said optical beam for acceptance by said circular multimode optical fiber.

15. A method of coupling a multimode laser to a multimode optical fiber, said method comprising the steps of:

generating a multimode laser beam in a multimode laser source having an aperture; and

positioning a multimode tapered structure to face said laser aperture, said multimode tapered structure coupling said multimode laser to said multimode fiber, said multimode tapered structure having an input end and an output end, said input end having an elliptical cross section for coupling with said multimode laser and said output end having a circular cross section for coupling with said multimode optical fiber.

16. A method for fabricating a multimode tapered structure for coupling a multimode laser to a multimode optical fiber, said multimode tapered structure having an input end and an output end, said input end having an elliptical cross section for coupling with said multimode laser and said output end having a circular cross section for coupling with said multimode optical fiber, said method comprising the steps of:

selecting a cylindrical rod of fused silicon material having a uniform index and a diameter equal to a core diameter of said multimode fiber;

grinding said input end of said cylinder rod to obtain said elliptical cross section and tapering of said cylinder rod from a smaller dimension at said input end to a larger dimension at said output end; and

fusing said rod to said multimode optical fiber.